

WHAT IS CLAIMED:

1. A method of making a dip-coated covered stent for use in a body lumen, comprising:

providing a mandrel coated with a biocompatible polymer to form a base coat layer thereon;

5 providing a plurality of cylindrical stent rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second implanted diameter, aligned on a common longitudinal axis;

mounting the plurality of cylindrical stent rings onto the mandrel to form a mandrel assembly wherein the rings are spaced an equal distance apart from each  
10 other;

depositing the mandrel assembly in a polymer solution to form a dip-coated covered stent; and

removing the dip-coated covered stent from the mandrel.

2. The method of claim 1, wherein the mandrel is formed of a material from the group consisting of teflon (PTFE), nylon, polyimide, polyethylene, and PET.

3. The method of claim 1, wherein the polymer solution cures to form the base coat layer of the mandrel prior to mounting the cylindrical rings thereon.

4. The method of claim 1, wherein the cylindrical rings are formed from a metallic material taken from the group of materials consisting of stainless steel,

titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

5. The method of claim 1, wherein the cylindrical rings are formed from a material taken from the group consisting of liquid crystallin, and liquid crystallin blends with other polymers, ceramics, and ceramic-reinforced polymers.

6. The method of claim 1, wherein flexibility of the stent increases when the distance between the cylindrical rings increases.

7. The method of claim 1, wherein the mandrel assembly is deposited in the polymer solution by dip-coating.

8. The method of claim 1, wherein the biocompatible polymer covering the cylindrical rings is taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA- type tri-block polymer, polyether-amide thermoplastic elastomer, fluoroelastomers, polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer, polyacrylate elastomer, nitrile, rubber, a family of elastomers composed of styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers augmented with antioxidants, bioactive polymers augmented with image enhancing materials, ceramics, polymers having a proton (H<sup>+</sup>) core, polymers augmented with

protons (H<sup>+</sup>), polyester copolymer elastomers, biodegradable polymers, polyethylene, polycaprolactone, PLLA, PLA, PGA, PLGA, polyanhydrids, polyphothazenes, polyorthoesters, Elasteon<sup>®</sup>, chitosin alginate, collagen, and elastin.

9. The method of claim 1, wherein prior to mounting the cylindrical rings on the polymer coated mandrel, the polymer is cured on the mandrel assembly.

10. The method of claim 1, wherein the method of dip-coating the mandrel assembly in the polymer solution is repeated until the polymer covering the cylindrical rings attains a thickness of about 25 microns to 200 microns.

11. The method of claim 1, wherein the cylindrical rings have a thickness of about 25 microns to 350 microns.

12. The method of claim 1, wherein each end of the dip-coated covered stent is trimmed.

13. The method of claim 1, wherein a perforated pattern is cut into the dip-coated covered stent.

14. The method of claim 1, wherein a drug is incorporated within the layer of the biocompatible polymer coating the cylindrical rings.

15. The method of claim 14, wherein the drug includes antiplatelets, anticoagulants, antifibrins, antithrombins, and antiproliferatives.

16. The method of claim 14, wherein the cylindrical rings consist of three layers, including a primer coat, a middle layer of the polymer with the drug incorporated therein, and a top coat.

17. The method of claim 16, wherein the three layers combined have a thickness of about 3 microns to 300 microns.

18. The method of claim 16, wherein the middle layer of the polymer with the drug incorporated therein has a thickness of about 2 microns to 150 microns.

19. The method of claim 1, wherein a luminal side of the rings are asymmetrically coated.

20. The method of claim 1, wherein the luminal side of the rings are asymmetrically coated with at least one of heparin, IIb/IIIa inhibitors, PEG, and hyaluronic acid.

21. A method of making a hybrid stent having alternating rings and links formed of a biocompatible polymer material for use in a body lumen, the method comprising:

providing a plurality of cylindrical stent rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second implanted diameter, aligned on a common longitudinal axis;

5 providing a mandrel assembly having stent-patterned grooves and connector channels encased within a plurality of outer mold covers;

positioning the plurality of cylindrical stent rings into the stent-patterned grooves of the mandrel;

injecting the polymer into the mandrel assembly; and

removing the hybrid stent from the mandrel assembly.

22. The method of claim 21, wherein the mandrel is formed of a material from the group consisting of teflon (PTFE), nylon, polyimide, polyethylene, and PET.

23. The method of claim 21, wherein the cylindrical rings are a metallic material formed of stainless steel, titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

24. The method of claim 21, wherein the cylindrical rings are formed from a material taken from the group consisting of liquid crystallin, and liquid crystallin blends with other polymers, ceramics, and ceramic-reinforced polymers.

25. The method of claim 21, wherein at least some of the rings are formed from the biocompatible polymer material.

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26. The method of claim 21, wherein the biocompatible polymer forming the cylindrical stent rings and links is taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA- type tri-block polymer, polyether-amide  
5 thermoplastic elastomer, fluoroelastomers, polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer, polyacrylate elastomer, nitrile, rubber,  
10 a family of elastomers composed of styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers augmented with antioxidants, bioactive polymers augmented with image enhancing materials, ceramics, polymers having a proton (H<sup>+</sup>) core, polymers augmented with protons (H<sup>+</sup>), polyester copolymer elastomers, biodegradable polymers, polyethylene, polycaprolactone, PLLA, PLA,  
15 PGA, PLGA, polyanhydrids, polyphothazenes, polyorthoesters, Elasteon<sup>®</sup>, chitosin alginate, collagen, and elastin.

27. The method of claim 21, wherein the biocompatible polymer material fills at least some of the stent-patterned grooves and each of the connector channels within the mandrel assembly.

28. The method of claim 21, wherein the links are formed from the connector channels being filled with the biocompatible polymer material.

29. The method of claim 21, wherein a therapeutic drug is incorporated within the biocompatible polymer material.

30. The method of claim 21, wherein the alternating rings formed of the biocompatible polymer material are made porous for containing the therapeutic drug.

31. The method of claim 30, wherein the alternating rings formed of the biocompatible polymer material are made porous by using materials from the group consisting of PEG, NaCl, L-arginine, and poragen.

32. The method of claim 21, wherein the biocompatible polymer material forming the hybrid stent cures prior to being removed from the mandrel assembly.

33. The method of claim 21, wherein the polymer material coating the cylindrical rings attains a thickness of about 25 microns to 200 microns.

34. The method of claim 21, wherein the cylindrical rings have a thickness of about 25 microns to 350 microns.

35. The method of claim 21, wherein the cylindrical rings consist of three layers, including a primer coat, a middle layer of the polymer material with the drug incorporated therein, and a top coat.

36. The method of claim 35, wherein the three layers combined have a thickness of about 3 microns to 300 microns.

37. The method of claim 35, wherein the middle layer of the polymer material with the drug incorporated therein has a thickness of about 2 microns to 150 microns.

38. The method of claim 21, wherein the rings formed of the polymer material consist of a top coat.

39. The method of claim 38, wherein the polymer rings and the top coat have a thickness of about 25 microns to 800 microns.

40. A method of making a hybrid stent having alternating rings and links formed of a biocompatible polymer material and a metallic material for use in a body lumen, the method comprising:

5 providing a plurality of cylindrical stent rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second implanted diameter, aligned on a common longitudinal axis;

providing a mandrel assembly having stent-patterned grooves and connector channels encased within a plurality of outer mold covers;

10 positioning at least some of the cylindrical stent rings into the stent-patterned grooves of the mandrel;

injecting the polymer into the mandrel assembly; and

removing the hybrid stent from the mandrel assembly.



41. A method of making a hybrid stent having alternating rings formed of a biocompatible polymer material and a metallic material for use in a body lumen, the method comprising:

providing a plurality of cylindrical stent rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second implanted diameter, aligned on a common longitudinal axis;

providing a mandrel assembly having stent-patterned grooves encased within a plurality of outer mold covers;

positioning at least some of the cylindrical stent rings into the stent-patterned grooves of the mandrel;

injecting the polymer into the mandrel assembly;

removing the hybrid stent from the mandrel assembly; and

attaching a peak of the polymer ring to the peak of the adjacent metallic ring.

42. The method of claim 41, wherein the peak of the polymer ring is attached to the peak of the adjacent metallic ring by welding.

43. The method of claim 41, wherein each end section of the hybrid stent is formed of the biocompatible polymer material.

44. The method of claim 41, wherein a drug is incorporated within the biocompatible polymer material of the alternating polymer rings.

45. A method of making a laminated, linkless polymer stent for use in a body lumen, the method comprising:

providing a plurality of flexible cylindrical rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second  
5 implanted diameter, aligned on a common longitudinal axis;

mounting a first polymer tube on a mandrel;

inserting the rings on the first polymer tube;

placing a second polymer tube around the first polymer tube having the  
rings inserted thereon;

10 placing a shrink tubing over the second polymer tube;

applying heat and pressure to the shrink tubing; and

removing the shrink tubing and the mandrel from the laminated, linkless  
polymer stent.

46. The method of claim 45, wherein the cylindrical rings are formed from a metallic material taken from the group of materials consisting of stainless steel, titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

47. The method of claim 45, wherein the polymer tubes are taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA- type tri-block polymer, polyether-amide thermoplastic elastomer, fluoroelastomers,  
5 polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer,

polyacrylate elastomer, nitrile, rubber, a family of elastomers composed of styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers augmented with antioxidants, bioactive polymers augmented with image enhancing materials, ceramics, polymers having a proton (H<sup>+</sup>) core, polymers augmented with protons (H<sup>+</sup>), polyester  
5 copolymer elastomers, biodegradable polymers, polyethylene, polycaprolactone, polyester polycaprolactone copolymers, PLLA, PLA, PGA, PLGA, polyanhydrids, polyphothazenes, polyorthoesters, Elasteon<sup>®</sup>, chitosin alginate, collagen, and elastin.

48. The method of claim 45, wherein the application of heat and pressure to the shrink tubing is effected by laser bonding.

49. The method of claim 45, wherein a drug is incorporated within the polymer tubing.

50. A method of making a laminated, linkless polymer stent for use in a body lumen, the method comprising:

providing a plurality of flexible, cylindrical rings being expandable in a radial direction, each of the rings having a first delivery diameter and a second  
5 implanted diameter aligned on a common longitudinal axis;

mounting a first polymer tube on a mandrel;

inserting the rings on the first polymer tube;

placing a second polymer tube around the first polymer tube having the rings inserted thereon;

10 applying simultaneous heat and pressure to an inner surface of the first polymer tube and an outer surface of the second polymer tube; and

removing the mandrel from the laminated, linkless polymer stent.

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51. The method of claim 50, wherein the simultaneous application of heat and pressure to the inner and outer surfaces of the first and second polymer tubes is effected by blow molding.

52. The method of claim 50, wherein blow molding the inner and outer surfaces of the first and second polymer tubes effects the lamination of the metallic rings.

53. The method of claim 50, wherein a drug is incorporated within the polymer tubing.

54. A dip-coated covered stent for use in a body lumen, comprising:  
a biocompatible polymer forming a base coat layer is formed on a mandrel;

5 a plurality of cylindrical stent rings being expandable in a radial direction, each of the rings having a first delivery diameter, and a second implanted diameter, aligned on a common longitudinal axis;

the cylindrical stent rings being mounted onto the mandrel so that the rings are spaced an equal distance apart from each other; and

10 coating the cylindrical stent rings with a polymer solution to form a dip-coated covered stent having the polymer base layer and the polymer coating around the cylindrical stent rings.

55. The stent of claim 54, wherein a perforated pattern is cut into the polymer coating.

56. The stent of claim 54, wherein the cylindrical rings are formed from a metallic material taken from the group of materials consisting of stainless steel, titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

57. The stent of claim 54, wherein the cylindrical rings are formed from a material taken from the group consisting of liquid crystallin, and liquid crystallin blends with other polymers, ceramics, and ceramic-reinforced polymers.

58. The stent of claim 54, wherein the biocompatible polymer material is taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA- type tri-block polymer, polyether-amide thermoplastic elastomer, fluoroelastomers, polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer, polyacrylate elastomer, nitrile, rubber, a family of elastomers composed of styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers augmented with antioxidants, bioactive polymers augmented with image enhancing materials, ceramics, polymers having a proton (H<sup>+</sup>) core, polymers augmented with protons (H<sup>+</sup>), polyester copolymer elastomers, biodegradable polymers, polyethylene, polycaprolactone, PLLA, PLA, PGA, PLGA, polyanhydrids, polyphothazenes, polyorthoesters, Elasteon<sup>®</sup>, chitosin alginate, collagen, and elastin.

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59. An intravascular stent for use in a body lumen, comprising:

a plurality of flexible cylindrical rings being radially expandable, each of the rings having a first delivery diameter and a second implanted diameter aligned on a common longitudinal axis;

5 each of the rings being formed of a metallic material and covered with a biocompatible polymer material;

a plurality of flexible links formed from the polymer wherein each of the links has sufficient column strength to axially separate the cylindrical rings; and

at least one link being attached between adjacent rings to form the stent.

60. The stent of claim 59, wherein each of the polymer links has a first end and a second end, the first and second ends being attached to adjacent cylindrical rings to connect adjacent cylindrical rings together.

61. An intravascular stent for use in a body lumen, comprising:

a plurality of flexible cylindrical rings being radially expandable, each of the rings having a first delivery diameter and a second implanted diameter aligned on a common longitudinal axis;

5 at least some of the cylindrical rings being formed of a metallic material alternating with cylindrical rings being formed of a biocompatible polymer material;

a plurality of flexible links formed of the polymer and each of the links having sufficient column strength to axially separate the cylindrical rings; and

at least one link being attached between adjacent rings to form the stent.

62. The stent of claim 61, wherein the alternating pattern of metallic rings and polymer rings includes any configuration of metallic rings and polymer rings along the longitudinal axis of the stent.

63. The stent of claim 61, wherein the cylindrical rings are formed from a metallic material taken from the group of materials consisting of stainless steel, titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

64. The stent of claim 61, wherein the biocompatible polymer tube is taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA- type tri-block polymer, polyether-amide thermoplastic elastomer, fluoroelastomers, polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer, polyacrylate elastomer, nitrile, rubber, a family of elastomers composed of styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers augmented with antioxidants, bioactive polymers augmented with image enhancing materials, ceramics, polymers having a proton (H<sup>+</sup>) core, polymers augmented with protons (H<sup>+</sup>), polyester copolymer elastomers, biodegradable polymers, polyethylene, polycaprolactone, polyester polycaprolactone copolymers, PLLA, PLA, PGA, PLGA, polyanhydrids, polyphothazenes, polyorthoesters, Elasteon<sup>®</sup>, chitosin alginate, collagen, and elastin.

65. A laminated, linkless polymer stent for use in a body lumen comprising a plurality of flexible cylindrical rings being expandable in a radial direction, the rings being in communication with a first polymer tube and a second

polymer tube, wherein the first and second polymer tubes are laminated together encapsulating the rings therein.

66. The laminated, linkless polymer stent of claim 65, wherein a shrink tubing is in communication with an outer surface of the second polymer tube.

67. The laminated, linkless polymer stent of claim 65, wherein the first and second polymer tubes are laminated together through the application of heat and pressure to the shrink tubing covering the second polymer tube.

68. The laminated, linkless polymer stent of claim 65, wherein the cylindrical rings are formed from a metallic material taken from the group of materials consisting of stainless steel, titanium, nickel titanium, tantalum, gold, cobalt-chromium, platinum, palladium, and iridium.

69. The laminated, linkless polymer stent of claim 65, wherein the polymer tubes are taken from the group of polymers consisting of polyurethanes, polyetherurethanes, polyesterurethanes, silicone, thermoplastic elastomer, sulfonated A-BA-type tri-block polymer, polyether-amide thermoplastic elastomer, 5 fluoroelastomers, polyvinylidene fluoride (PVDF) and copolymers of PVDF, fluorosilicone elastomer, styrene-butadiene-styrene rubber, styrene-isoprene-styrene rubber, polybutadiene, polyisoprene, neoprene (polychloroprene), ethylene-propylene elastomer, chlorosulfonated polyethylene elastomer, butyl rubber, polysulfide elastomer, polyacrylate elastomer, nitrile, rubber, a family of elastomers composed of 10 styrene, ethylene, propylene, aliphatic polycarbonate polyurethane, polymers



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